ENGINEERING NEWS.

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THE MULTIFOLD WATER FILTER.

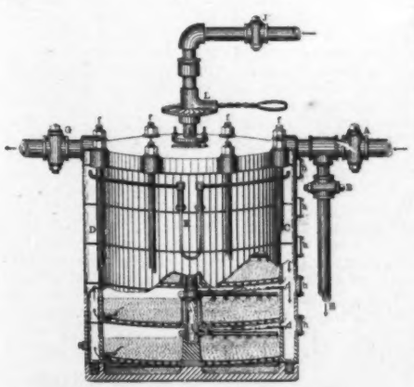
The subject of pure water is one in which all are interested, and any suggestions leading to a solution of the much discussed and we may say much abused question, how to produce a permanant supply of pure water from sources which, owing to their location become polluted and contaminated by the addition of foul matter and substances liable to decompose under most conditions, will be of interest to scientists, engineers, cities, manufacturers and all consumers of water.

It is unnecessary to state that filtration through beds of sand or other separating mediums will greatly benefit and, in most cases, entirely purify water containing suspended matter. This is too thoroughly understood to require argument. The problem has been to reduce the space required by the old method of sand bed filtration to a minimum, to cleanse the filtering beds of accumulated silt, which retards and would ultimately prevent the passage of water, and to accomplish these results on a large scale and at small cost.

The answer to this problem is pretty thoroughly embodied in the Multifold Filter, manufactured and sold by The Newark Filtering Co., at 177 Commerce street, Newark, N. J.

This filter is constructed on an entirely new and novel plan, and is amply protected by letters patent in the United States and principal foreign countries.

This filter derives its name from its construction, the filtering area on a given ground space being increased or multiplied by placing a number of cylindrical compartments or beds one above the other.



These beds are of cast and wrought iron, and vary in diameter from 20 to 96 inches and in depth from 12 to 24 inches, according to the nature of the water and the degree of filtration required, the number of beds being varied to suit the required capacity. Thus is attained from three to ten times the filtering area and capacity obtained by any other method now in existence.

The filtering material is sustained in the compartments upon sheets of finely-perforated brass, manufactured under a new and patented process. These brass plates, which are supported at a proper distance from the bottom of bed, allow the free passage of water, but prevent the escape of sand. Water to be filtered is admitted through the valve *A* to the common inlet passage *C*, through the subordinate inlets *d* to the surfaces of the filter beds. In its passage through the filtering material the water becomes purified, passes through the spaces between the perforated brass and the bottoms, thence through the outlet ports *g* and *D* and valve *G*. The hand-hole plates *h* afford access to all parts.

Each compartment forms an independent filter bed, and all joined together in one apparatus by the bolts *f*, afford a large capacity on a small ground space.

When the filter needs cleaning the mercury gauge *K*, connecting with inlet and outlet, will indicate a resistance of 2 to 4 lbs. per square inch.

The method of cleansing or washing the filter beds forms another distinctive feature of this filter. It is accomplished by means of traveling jets of water applied to the beds through the radial washer pipes *b*, from the main vertical washer pipe *J*, which passes through all the compartments, at a sufficient pressure to thoroughly agitate all of the filter beds. The effect of this is to detach all of the impurities, which, being of inferior specific gravity, rise and pass with the water out of the filter through the ports *d* and waste outlet *E*. The semi-circular ribbed guards, or rippling plates, prevent the sand from escaping with the waste water.

Where two or more filters are used conjointly, the progress of filtration is not interrupted during the washing, and, in case a single filter is used, the interruption lasts but three or four minutes.

It is claimed that this filter obviates all of the difficulties experienced by other manufacturers; that it economises ground space; that it rapidly and effectually cleanses the filtering beds without the necessity of removing and replacing them; and that is applicable on a large scale.

The Multifold Filter will cleanse the water supply of the largest cities, and of paper mills, dye works, laundries, steam boilers, etc., and is adapted to both high and low pressure.

ATTEMPTED LEGISLATION IN MICHIGAN IN RELATION TO SURVEYS.

ANN ARBOR, Mich., Dec. 29, 1881.

EDITOR ENGINEERING NEWS:

From time to time organizations of surveyors in several of the Western States have tried to secure the passage of such laws as they thought would improve the practice of surveying, and cut off incompetent persons, of whom there are many. The statement of the attempt and result in the Michigan legislature last winter may help our brethren towards a solution of the problem, as we can learn from other failures. I hope it may not be found too long for your columns.

Yours truly,
CHAS. E. GREENE.

The Michigan Association of Surveyors and Civil Engineers, at their second meeting, at Lansing, in January, 1881, appointed a committee to consider and report upon desired legislation, to provide for organizing the surveying service of the State; to secure uniformity of practice, use of standard measure, and for the more complete recording of surveys of a permanent nature. As surveyors in other States have been discussing the expediency of similar steps, it is not unlikely that they may learn something from the failure of the last trial by the Michigan Association to bring about a reform, and we therefore give the bill which was introduced into the Senate through the efforts of the above committee, Jan. 21, 1881, was reported without amendment by Committee on State Affairs, and passed the Senate with little opposition.

A Bill to establish a Board of Commissioners of Surveys, to prescribe their duties, and to fix their compensation; and to further provide for the public surveys.

Sec. 1. The People of the State of Michigan enact, That a State Board of Commissioners of Surveys is hereby established, to be composed of three members, each of whom shall have been for at least five years before his appointment a practical land surveyor within this State. The members of the board shall be appointed by the Governor, with the advice and consent of the Senate. The members first appointed shall be designated by the Governor—one for the term of office for two years, one for the term of office for four years, and one for the term of office for six years; and thereafter the Governor, with the advice and consent of the Senate, shall bi-annually appoint one member to hold his office for six years, ending May fifteenth. Any vacancy in said board may be filled until the regular session by the Governor.

Sec. 2. Each member of said board shall take the constitutional oath of office before some officer authorized to administer oaths, and shall enter into bonds with the people of the State of Michigan in the penal sum of three thousand dollars, with sureties to be approved by the Governor, conditioned for the faithful and impartial performance of the duties of his office, and shall file such bond and oath of office in the office of the Secretary of State.

Sec. 3. That member of the board whose term of office will soonest expire shall be the chairman thereof. The board, or a majority thereof, shall hold regular meetings at the State land office in Lansing on the last Wednesday of January in each year.

Sec. 4. The Commissioner of the State Land Office shall, at the first regular meeting of said board, designate one of the regular clerks of his office to act as secretary thereof. It shall be the duty of such secretary to attend the sittings of the board, to record its proceedings, to preserve its books, papers and property, attend to its correspondence, and perform such other duties as may be required of him by said board.

Sec. 5. The board shall be a board of examiners, and shall make public examinations of persons for land surveyors. Every person desiring to practice as a land surveyor within this State shall give notice to the secretary of the board at least two weeks previous to a regular meeting thereof; and at the meeting designated such applicant shall appear in person, and, when required by the board, bring his instruments; and previous to such examination shall satisfy the board that he is a person of probity and sobriety.

Sec. 6. The board shall examine such applicant with regard to his proficiency in mathematics as applied to surveying, the United States public land system, the adjustment of instruments, map-drawing and the recording of surveys, and with special reference to the actual practice of the applicant in the field, his previous preparation and experience, and may require the applicant to perform such practical operations in their presence as they may deem necessary.

Sec. 7. The board, after being satisfied of the ability of the applicant, as provided in section six of this act, and of the sufficiency and correctness of his instruments, and, after such applicant shall have taken the constitutional oath of office and paid into the treasury of the State of Michigan the sum of five dollars, shall make and deliver to him a certificate in the following form, to wit:

This is to certify that ——, of ——, in the County of ——, in the State of Michigan, has duly passed his examination before the State Board of Commissioners of Surveys of the State of Michigan, and has been found qualified to perform the duties of land surveyor. Wherefore, the said —— is hereby authorized to practice as a land surveyor, with authority to take testimony in all matters pertaining to his profession, and administer oaths to his assistants within and in any part of the State of Michigan until this appointment and authority shall be revoked.

[Signed] —— } Board of Commissioners of Surveys.
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But said board of commissioners, if they find an applicant is not sufficiently qualified, or, if from his inexperience in the field he does not seem to have sufficient practical acquaintance with his profession, shall encourage him to prepare himself for further examination.

Sec. 8. The secretary of the board shall, before the delivery of any such certificate, make a record thereof. Any surveyor holding such certificate shall be deemed a registered surveyor, within the meaning of this act.

Sec. 9. The board shall revoke the appointment of any registered surveyor whom they may find guilty of gross negligence or corruption in the execution of the duties of his office; but not without having previously summoned him to appear, in order to be heard in his defense, nor without having heard the evidence offered either in support of the complaint or in behalf of the surveyor inculpated.

Sec. 10. The board shall send to the County Clerk of each county at the close of each regular meeting a list of the names of all surveyors to

whom they have at such meeting granted certificates, and of those whose appointments have been at that time revoked.

Sec. 11. The board of commissioners of surveys is hereby required to provide itself at the expense of the State with suitable standards of length from the office of the United States Inspector of Weights and Measures.

Sec. 12. Every registered surveyor shall provide himself with a standard of lineal measures, which shall be certified by the secretary of the board, or by the United States Inspector of Weights and Measures, as being correct with the U. S. standard of length, and he shall keep his chains and tapes used in agreement with such standard.

Sec. 13. The board of commissioners of surveys shall be an advisory board on questions of boundary, extinct or disputed corners, and all difficult questions of surveying practice submitted to them by registered surveyors.

Sec. 14. The said board shall endeavor to secure uniformity in the practice of registered surveyors; and in re-establishing and perpetuating the United States surveys, they shall endeavor to conform to the plan on which these surveys were made, to the end that lost corners and lines may be re-established in their original positions.

Sec. 15. Each member of the board of commissioners of surveys shall receive ten cents a mile for each mile necessarily traveled in going to and returning from their place of meeting at the capitol at Lansing, and his necessary expenses during the session of said board; said mileage and expenses shall be allowed by the Board of Auditors and paid by the State Treasurer on the warrant of the Auditor General. The necessary expenses of said board for stationery and instruments for their office and for their secretary while engaged in the performance of his duties shall be audited and allowed by the Board of State Auditors and paid by the State Treasurer on the warrant of the Auditor General.

Sec. 16. Each registered surveyor shall keep a full and complete record of surveys made by him in a book of such form and size as shall be prescribed by the board of commissioners of surveys, and within ten days previous to the first day of January of each year, shall, at his own expense, deposit said record in the office of the County Surveyor of the county in which the surveys were made, and each county surveyor receiving such record shall give to the person depositing the same a receipt therefor; but no record shall be received by such county surveyors unless made by a registered surveyor whose certificate, as shown by the list on file in the County Clerk's office, was in full force at the time the survey was made. The expense of making a record of any surveys made by a registered surveyor shall be paid by the persons for whom the survey was made in proportion to the amount of work done for each.

Sec. 17. The record, or a certified transcript thereof of any survey made by such registered surveyors, shall be received as presumptive evidence of the facts therein set forth in all courts of record in this State.

Sec. 18. Whenever a majority of the resident owners of any section, or part or parts of any section of land in this State shall desire to have their corners or lines, or any of them, established, located, or perpetuated, they may apply to a registered surveyor to make the required surveys, who shall immediately give to the applicant a notice, who is hereby required to serve the same on all other persons owning land in the same section, or to their agents residing in the same township, informing them that at a day mentioned, not less than ten days from the date of the notice, the required surveys will be made.

Sec. 19. The registered surveyor, being satisfied that notice has been given, and no injustice will be done the parties not signing the application, shall make the surveys asked for; and the expense thereof shall be borne by all the persons benefited in proportion to the work done for each, to be determined by the surveyor; and if any person thus benefited shall refuse or neglect to pay his share of such expense, such surveyor shall certify the same, and to whom due, to the supervisor of the proper township, who shall assess it upon the land of such person, to be collected in the same manner as other taxes, and held subject to the order of the person named in the surveyor's certificate as being entitled to the same: *Provided*, In such cases the surveyor shall not charge to exceed four dollars a day, including the time of traveling to and from the place of making the survey and of making record of the same.

Sec. 20. No registered surveyor shall be liable to prosecution in an action of trespass for entering upon any lands in the discharge of his duties.

This bill, after passing the Senate, was introduced in the House and referred to the Committee on Geological Survey, who later made a report giving the following objections:

1. Section 1 creates a board of three additional State officers, with various but no useful or important duties. No other State officers can perform their duties or receive the appointments, as the bill provides that they shall be practical surveyors of at least five years' experience. This board is by this bill granted power, in sections 11 and 15, to provide instruments, some of which may be very costly, to be paid for out of the treasury of the State, and there is no provision controlling or limiting this dangerous power to be found in this bill. And your committee are of the opinion that it is unwise and impolitic for this Legislature to create a board of three additional State officers with no better prospects of returning profits than are afforded by the provisions of this bill.

2. The bill is unjust to the surveyors of the State. Section 3 provides that any person wishing to practice as a registered surveyor must first give notice to the board and then come to Lansing and be examined; and as the board meets only in midwinter, the whole upper peninsula would be excluded from the benefits of the bill or be subjected to great cost, as well as all other distant parts of the State. Again, section 7 prescribes the form of certificate which shall be granted, which is liable to deceive the holder, as it declares that he has authority to take testimony and administer oaths, while nowhere in the bill is there granted even the power to swear a flagman—no, not even to swear at him.

3. This bill does not provide for making surveys according to the laws of the State. Section 14 provides that the board shall endeavor to secure a uniformity of surveys, but does not provide that they shall be made in accordance with the laws of the State. And so with the records; the statutes provide a form for record of surveys, but this bill provides that a uniform record shall be prescribed by the board for registered surveyors, but fails to provide that it shall comply with the law of the State; and such record shall be filed with the county surveyor at the close of each year, thus making as many separate record books in the surveyor's office as there are surveyors working in his county, and these doubling each year as time goes on. This provision in the bill is very objectionable, causing, as it would, great confusion and trouble in preserving, and especially in finding, the records. Again, section 16 forbids county surveyors receiving any but the records of registered surveyors. This provision will be held as prohibiting the county surveyor from receiving the records of his own deputies.

4. Section 17 provides that the record of a registered surveyor shall be evidence in courts of records, yet the bill does not provide that either the survey or record shall be made in accordance with laws of the State. The statutes provide the manner of making surveys and records by county surveyors, and their record is evidence in all courts; so a court may be compelled by this bill to receive as evidence the record of a registered surveyor fixing a corner at a certain point, and also that of the county surveyor showing that it is 4 rods from there. Therefore this provision is extremely mischievous and objectionable.

5. Section 19 grants power to a registered surveyor to do work, and at his own discretion, and without appeal, to cause to be levied on your farms taxes that must be paid as he has apportioned them: and section 20 empowers him to enter your premises with impunity; and yet nowhere in this bill is there any provision that he shall give a bond for the just apportionment of your taxes, or that he will not do damage to your property while upon your premises. He has all the above powers and yet you cannot command his services, as there is no provision in this bill to compel him to make a survey unless he pleases, as is the case with county surveyors; not even a court can compel or command his services; he is by this bill above all law.

6. It is claimed by the surveyors' association who drafted this bill that it will secure greater accuracy and uniformity in making surveys, and in their records. But your committee find that the present statutes direct how surveys shall be made and also for a specific and uniform record of the same. Therefore this bill can be of no benefit in that direction, and if the board of surveys should prescribe a different method of making surveys or records, it could only produce conflict and confusion, and result in great harm to the service. And your committee would further report that they have thoroughly examined and carefully considered the numerous petitions and many letters for and against the adoption of the bill, and after such careful consideration your committee are of the opinion that the measure would be a needless expense to the State and a damage to the surveying service and to the surveyors themselves. Your committee therefore respectfully report the bill back to the House and recommend that it do not pass, and ask to be discharged from the further consideration of the subject.

(Signed by the Committee.)

The report was accepted and the bill was then laid on the table.

Work is progressing on the railroad from Queretaro to Leon, Mexico, and several bridges are in course of construction.

CORRESPONDENCE.

WHAT IS RAILROAD GRADING?

ST. ALBANS, Vt., Dec. 24, 1881.

EDITOR ENGINEERING NEWS:

I noticed on page 505 of your paper of the 17th inst. the question for railroad experts, "What is grading?"

An experience of many years in railroad construction and work has made me decidedly of the opinion that the term grading is confined to the various excavation from the cuts and constructing the embankments on a line of road, or, as the specification for the Vermont Central Railroad states it, "Under the head of grading shall be included all excavations and embankments required for the formation of the road-bed; all necessary turnouts; the preparation of depot grounds; all ditching and digging for foundations of all masonry." And the Ohio & Pennsylvania Railroad specifications have a similar definition of the term grading, as follows: "Grading includes all excavations and embankments required for the formation of the road-bed; cutting all ditches or drains or foundations of culverts; small bridges and walls, and the excavation necessary for reconstructing highways, turnpikes, or common roads connected with or incidental to the construction of said railroad."

The following railroads had the same definition of the term grading in their specifications: The Ohio & Mississippi; Pennsylvania; Baltimore & Ohio; Norfolk & Petersburg; Worcester & Nashua; Newburgh Branch of the N. Y. & Erie; Connecticut River; Hartford & New Haven; Cheshire.

In each of these cases they invariably make a separate statement concerning the masonry, and agree in their explanation as to what the term grading includes. I have never seen a specification that gave any other definition of that word than the above quoted, and so, if you please, you may set me down as a very positive believer in the correctness of it. Respectfully yours,

WM. E. BABBIT.
Chief Engineer C. V. R. R.

THE METRIC SYSTEM ON MEXICAN RAILWAYS (*PRO*).

GUANAJUATO, Mex., Dec. 8, 1881.

EDITOR ENGINEERING NEWS:

Some two years and a half ago I published in your valuable paper an article entitled *The Application of the Metric System in Laying Out Railroad Curves.*

At the time it did not attract much attention, but since the advent of railroad building here in Mexico, it is brought more into prominence.

Many engineers residing in the States at the time held up their hands in "holy horror" at the attempted innovation, and in language more terse than elegant swore they would never use the "new fangled" system in their practice.

Nor is this an exaggeration, for I was personally informed by an engineer (now dead) connected with the Mexican National Railroad, that had he known that the metric system was in use in Mexico, before leaving the United States, he certainly would have remained there. So much for prejudice. I do not want to call it by any harder name. A great many engineers of the same class were certainly astonished when on their arrival in Mexico (having accepted situations on the numerous lines now building), they discovered that the *Metric System* was prescribed by the Mexican government, and that they (the engineers) must use the same whether or no.

At the time of writing the article aforesaid, I little dreamed that it would be my fortune soon to practice what I preached. Before leaving the "States" I was not aware what system was in use there (here), never having given the subject any thought, other matters being uppermost in my mind at the time. When, after my arrival, I found that the metric system was the one to be employed, I did not manifest any displeasure at the discovery. Here was a chance to test the same practically, and thus ascertain whether it deserved the merit claimed for it or not.

But to the details of the same, as applied on the Mexican Central Railway, i. e., *Ferrocarril Central Mexicano*, as to the length of the chain. In my article I advocated (for peculiar reasons) a chain of 20 meters. The Mexican Central uses a chain of 25 meters in length, thus making 40 chains to the kilometer. Every meter is marked by a round tag with the appropriate number stamped thereon. Some of the chains are composed of 125 links, each 2 decimeters long, while others are 2.5 decimeters in length, making 100 links to the chain. I am at a loss to state which number is to be preferred, as peculiar advantages can be shown for either. I will, therefore, not attempt any discussion in favor of one, but let everybody "pay their money and take their choice." As the length of the chain is the basis of the chord employed in laying out the curves, therefore all radii are calculated for that length of chord (25

meters), these radii of course varying from those given in my article, I having assumed 20 meters as the length.

In running lines as practiced here, a stake is placed at the end of every chain, beginning at 1 and numbered consecutively, the limit of curve being the length of the survey.

Should it be necessary to put in an intermediate stake then the *plus* is indicated according to the number of meters from the last *station*. For instance, the last number is 28 and a stake is placed, say 12 meters in advance, then the stake is marked 28+12, which signifies *not* 28 meters plus 12 meters, but 28 stations plus 12 meters, or a total distance of 712 meters; the number of stations, 28, being mutiplied by 25, the length of a chain, and 12 meters then added. By mentally dividing by 4 the same result is obtained, as is apparent to every one.

In running curves the angles are deflected, as is usual, and according to the degree of curvature. The degree of curvature as in the United States is expressed by the center angle. I desire here to enter my protest against this method.

It would be far more desirable to express the degree of curvature by the deflection angle, that is, by the angle of deflection for one station, being one-half the center angle. It would simplify matters very much, and also be less liable to lead to mistakes, only one value being employed. As to profiles: The grade here is invariably expressed by the ratio of 1 to 100, or, in other words, so many per cent.; thus 1 per cent. being a rise (or fall) of 1 in 100, the rise (or fall) per station being thus always one-fourth of the percentage.

For profiles thus far the usual profile paper is being used, plate B, no paper ruled to metric values being obtainable.

The horizontal scale of the profile is taken at 100 meters per inch and the vertical scale at six meters per inch, making an exaggeration of 1 to 16⅔.

It would be desirable to have a profile paper ruled according to metric values, and I would offer the following suggestions to manufacturers of this class of engineering supplies:

Vertical lines one-half centimeters apart and every fourth line heavier than the rest. Horizontal lines ⅓ centimeters apart and every tenth line heavier than the others. According to this division the paper would be divided into heavy squares having sides of two centimeters, representing horizontally 100 meters and vertically five meters, being a distortion of one to twenty; or the horizontal lines could be one-fourth centimeters apart and every alternate line a slightly heavier one and every sixteenth still heavier, thus giving the same sized squares, two centimeters, as the other division. But in this case two centimeters vertically would represent eight meters, making a distortion of 1 to 12.5.

It will be observed that the first division corresponds with the profile paper, plate *A*, now in use, being 400 ft. to an inch horizontally and 20 ft. to an inch vertically, a distortion of 1 to 20.

The second division does not differ materially from that of plate *B*, 400 ft. to an inch horizontally and 30 ft. to an inch vertically, a distortion of 1 to 13⅓.

For location of maps the usual scale is $\frac{1}{2000}$, each centimeter representing one chain or 25 meters, expressed in English measures this scale equals 208⅓ ft. to 1 in.

For leveling the ordinary target rod is used, being divided into meters, decimeters and centimeters. Millimeters are read by means of the target. The rod is generallly 3.5 meters long when extended, the lower part reading up to 2 meters and the upper part the additional 1.5 meters.

The above facts I have hastily thrown together in order to give a general idea of the practical workings of the system. At a future time I will discuss the subject more elaborately and go more into details. I also add the appended original table, showing relative values of the metric and English systems.

Table of curvature and radii for chords of 25 meters, showing also corresponding values expressed in chords of 100 ft., one meter assumed at 3.281 ft.:

Degree of curvature.	Radii in meters.	Degree of curvature.	Radii in feet.
30'	1,432.41	1° 13' 9"	4,699.74
1°	716.23	2° 26' 18"	2,349.95
1° 30'	477.52	3° 39' 28"	1,566.74
2	358.17	4° 52' 38"	1,175.16
2° 30'	286.57	6° 5' 48"	940.24
3	238.84	7° 19'	783.63
3° 30'	204.75	8° 31' 12"	671.78
4	179.19	9° 45' 20"	587.92
4° 30'	159.31	10° 58' 40"	522.70
5°	143.42	12° 11' 57"	470.50
5° 30	130.42	13° 25' 13"	427.91
6°	119.58	14° 38' 36"	392.34
6° 30	110.42	15° 51' 56"	362.20
7°	102 57	17° 5' 5"	336.53

Respectfully, EMILE LOW.

THE METRIC SYSTEM ON MEXICAN RAILWAYS (*CON*).

MEXICO, Dec. 6, 1881.

EDITOR ENGINEERING NEWS:

The metric system, which has been so much agitated of late, I have had some experience here in testing. So far as it applies to railroad engineering I have no doubt of the general beneficial results which will accrue from its use; but I have much doubt of its being in all cases so much superior to what is now in use in the "States," and I think engineers will regret the day if they ever give up the convenient one hundred-foot chain for railroad work and the easy calculation that results from its use in curvature and earthwork, and also the feet graduation for railroad leveling.

I have, however, never heard the metric system advocated very much for railroad work, and so perhaps am merely setting up a man of straw to knock down. Here the metric system is obligatory on all the work in the republic; so it is not a matter of choice to be decided by the officers of the different roads. I do not know their private opinions, but give the conclusion arrived at by myself, and am ready to give reasons for the faith which is in me.

When coming to Mexico I was glad to hear that the metric system was there the lawful standard. Previously I had only taken a feeble interest in it, but had always thought that, like the dogmas of our religion, it was a good thing to have round, though I had spent but little thought in endeavoring to solve its mysteries. So I came here prejudiced in its favor, thinking the system would be a fine thing for railroad work. Why it has not been found to equal my expectations I will proceed to explain.

Our chain is twenty-five meters long, or eighty-two feet. Whether it would be better, as some have advocated, if in a length of twenty meters, I doubt, though that would be more convenient for curvature. Now, all curve work is necessarily easier with a cord of one hundred units, than with the number twenty-five or even twenty. If the chain was one hundred meters, of course it would be as convenient, but this would be too long for one; in other words, it would be impracticable. If the chain was ten meters, it would be handy as to the division, but would be too short, and no other length with one unit figure and ciphers can be had. Again, the half of twenty-five gives three figures to be used; of one hundred, only one. This is the alignment part. For leveling, the feet are at such distances, that the eye can go from one to another through the object glass of the level. Again, a tenth is a convenient size for all railroad work, nothing finer being required, except on turning points, when hundredths is sufficiently accurate—two decimals. On the meter rod the meters cannot be easily followed by the leveler while looking through the telescope, and mistakes have been made on that account. This would only be partially remedied by marking the meter in connection with each decimeter. To get ordinary ground two decimals must be used. The decimeter being too coarse, and for turning, three, the centimeter not being fine enough. In cross section work 50 ft. is sufficiently close, excepting particular breaks in the ground (and sometimes 100 ft. apart is near enough), one figure only being used in calculation. In the metric chain, if the full length is used, two figures, if the half one, three, would have to be continually multiplied in summing up the earthwork. Respectfully, LAWRENCE BRADFORD.

RAILROAD TRAVELING IN GERMANY.

Whoever has enjoyed the comfortable and pleasant riding in the palace and parlor cars on some of the better American railways feels a distinct longing for them if chance ever takes him across the ocean, through any of the large foreign states. There, where the roads operate in densely settled districts, populous cities and numerous way-stations, *safety* is considered the principal component of the operating departments, and in the desire to further this cardinal feature of railroad management all other intentions—if any such ever existed—have become completely absorbed, so that now, while you are reasonably assured of a safe passage as contracted for, that is all you get, and all personal comforts and conveniences are generally neglected. It is decidedly different in the United States. Managers have long since noticed that to draw public patronage alleviations of the fatigues and discomforts of tiring journeys must be introduced in the operation of passenger trains. The percentage of disasters and deaths, though still large with us, is constantly on the decrease, and these features, with rapid transit, insure us from the competition of the world.

In Germany the passenger trains are made up of mixed coaches, that is, such as have subdivisions for first, second or third-class passengers. They are much smaller in length and lighter than the American coaches, and look a good deal like box cars in shape and size.

Each car has from five compartments up, seldom over eight or nine; each compartment is complete in itself, having no connection with those ahead or behind, and having only a door, with movable glass top on each side, as a means of entrance and exit. These doors, by the way, have the handle on the outside, so that when once closed they are virtually locked, imprisoning, to a certain extent, those inside. The only way for a passenger to open the door would be to let down the glass side and reach out to the handle, which, however, is strictly forbidden on all German roads, and just as strictly enforced, too.

The conductor walks a gang plank on the outside of the car to collect tickets, after which he is supposed to enter a little watch-tower attached to one of the cars of his section—this has the appearance of a small dry goods box perched on the end and side of the coach, and makes a comical appearance. Passenger trains are under control of a head conductor, with several sub-conductors, all uniformed, the latter having each from two to three cars in charge.

As soon as a station is reached, each sub-conductor opens the depot side of all of his compartments, calls out the name of the station, and regulates as much as possible the disposition of new travelers in his coaches. These sub-conductors seem to be usually quite susceptible to bribes, which generally insures the traveler a whole compartment to himself and friends or family. In first-class compartments there is place for six persons; the seats are made of rich velvet or plush upholstery, and trimmings to a certain extent decorative and tasteful. The second-class has room for eight persons; the seats are also upholstered, but not so well finished. The third-class, which is the one mostly used by the people at large, has wooden seats and place for ten persons. The rate for this class of passage is from a cent to a cent and a half per mile, and for return passages much less, as a reduction of one-third is generally made in such cases. Excursion rates are probably from one-half to three-quarters of a cent—hardly any more than the latter figure—which is cheap transportation sure enough.

There is yet a lower class—the fourth—operating, however, on only some of the roads. This class is intended for hucksters carrying truck to the cities, and is only local. The coach has no compartments, and what is strangest of all, no seats. The passengers are huddled together promiscuously, and find standing room as best they can!

One instance of the want of providing even the most necessary comforts is the total absence of drinking water or water-closets. No arrangement is ever made for the former. Where the latter has been attended to, a notice is posted in each compartment that a water-closet is provided for in one of the baggage cars; those desiring to use same must apply to the conductor, and at the next stopping place you are given the key, and naturally you must remain in there until the train reaches another station! This is probably one of the most absurd expedients that could have been hit upon.

Couplings are made in a very efficient manner, but altogether too slowly; you never hear of a detached car or broken sections.

Everything around the depots has a neat, clean and orderly appearance; all employés, except laborers, are uniformed, and as most of them are retired army officers and soldiers, their bearing is strictly military.

At all road crossings at grade-level, there is a watchman, who works the barriers on approach of trains. He is notified by telegraphic signals, works the barriers whether a wagon is there or not, presents arms, or rather safety flag, to the passing train, and then walks the track until the next train passes. They are provided with little houses immediately at the crossing and live there entirely. These little watch-houses are sprinkled all over the road every few miles apart.

The substantial manner in which the road-beds are originally constructed, does not require constant section and floating gangs of laborers, and the watchmen report the condition of track on their beat. Road repairs are therefore comparatively small on German roads. V. H. K.

STATE LINE MONUMENTS.

The lately surveyed line between the States of Pennsylvania and Ohio is being marked by stone monuments. They are about five feet long, leaving one foot visible above the ground, and are dressed to a point. On the east side the letter P is cut and on the west the letter O, while the north side records the number of miles distant from Lake Erie, and south the year of their erection. The new line, which, with these monuments, will be plain enough for anybody to distinguish, will prove of great value in settling disputes of property holders as to the State in which their taxes are due, and may also compel the changing of some roads which are either directly on the line or run back and forward over it.

SUBSIDY SECURED.—The track of the St. Louis, Jerseyville & Springfield Railroad reached the Mississippi River on the 31st, thus practically securing the subsidy of $100,000 and the right of way, provided the road reached the river in 1881.

ENGINEERING NEWS.

GEO. H. FROST.....PROPRIETOR.

Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.

A. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, JAN. 7, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States, Canada and the Sandwich Islands, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICE OF MEETINGS.

TELEGRAPH BROTHERHOOD.—A call has been issued for a convention of telegraphers, to be held in Pittsburgh on the first Monday in March next, "for the purpose of forming an international telegraphers' organization, having for its object the amalgation of all existing telegraph organizations into one grand brotherhood." Each city, town and division of road is to be represented by one delegate, and an additional delegate will be allowed for every fifty operators employed.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The Twenty-ninth Annual Meeting will be held at 127 E. Twenty-third street, New York City, on the 18th inst., at 10 a. m.

OHIO SURVEYORS.—The third annual session will be held at Columbus, Ohio, on the 11th, 12th and 13th inst., in the Board of Trade Rooms, City Hall Building. Several subjects of great interest to surveyors will be discussed.

THE YEAR WHICH HAS PASSED.

It is not unusual in enterprises such as ours to pause at intervals and consider how far the progress made is commensurate with the early hopes expressed, or with the efforts made, and also to take the public into the conference. So now, on the opening of the ninth year of our publication, we may be allowed to look back a short way, and, it may be, gather strength for new efforts in the consciousness of past success.

In the wide expanse of our country from ocean to ocean, occupied by a people overflowing with the spirit of adventure and enterprise, it was apparent that to the achievements of our engineers as a body, more than to any one class of operatives, we owed that material improvement which would prove the basis of our future as of our past success as a nation; and that a journal which aimed to chronicle from day to day the doings of this growing body of men was one that the spirit of the age called for. To meet this demand, so far as lay in his power, was the object of the proprietor of ENGINEERING NEWS, who aimed to make it what its name purported, engineering news pure and simple. But in the effort to do his *devoir* by his readers, he has been led to extend his labors to embrace, not only professional news, properly so called, but so much of technical instruction as he thought would be acceptable. To this end he has introduced, and will extend, as the encouragement to his labors may indicate its popularity, descriptions and illustrations of works either complete or in progress, or merely designed, which, although not "news" possibly to all his readers, yet must prove instructive to some of them, and to all serve as a record for future reference; and as an earnest of what he hopes to accomplish in this direction, it may not be amiss for him to point to what has been accomplished during a single year which has just closed, and while yet his purposes are in a measure undeveloped.

Taking the well known definition of the famous English engineer, Thos. Telford, as to what constitutes civil engineering, the proprietor of ENGINEERING NEWS has endeavored to cater to the wants of all who recognize their own professional status as embraced in that definition; and taken in the order of their duties comes the surveyor, the civil, the mechanical engineers, and then the contractor and builder; the combined labors of all resulting in a work of civil engineering.

Accurate surveys must be preliminary to any work of construction, and the proceedings of State conventions of surveyors; geodetic surveys; surveys of States; triangulations; the improvements in instruments; methods of laying out, providing for, and eliminating errors in, measurements; recording and preserving drawings; leveling, with improved methods of keeping field notes and hints for labor saving processes, and increased accuracy of results, have all received their share of attention in the volume just closed.

The formation of engineering societies as a potent means to advancement in science has kept pace with the increased calls upon the profession, and valuable papers upon all branches of construction will be found in their proceedings for the year, abstracts and copious notes from which form an interesting portion of our news, and are credited to the reports or proceedings of the various societies, as the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the Boston Society of Civil Engineers, the Civil Engineers' Club of Cleveland, Engineers' Club of Philadelphia, Engineers' Society of Western Pennsylvania, the Western Society of Engineers, the Michigan Association of Surveyors and Engineers, the Institution of Civil Engineers, the Liverpool Engineering Society and others, while the reports of city engineers furnish many valuable statistics. Much miscellaneous information, will also be found concerning the various principles and methods of practice, the materials in use, such as steel, iron, cement, timber, etc., etc., and tests for the same, with discussions on the merits of different plans, while details of their use in various constructions are interspersed throughout many papers, and appear but incidentally.

Of Engineering Structures the railroads take precedence in importance, and the accessories in use on them as suggested are largely represented, including rails, frogs, ballast, ties, earth-work, culverts, etc., and notices of important railroad works, either projected or in progress on this continent are given. Rapid transit in various cities, and comparisons between surface and elevated roads, underground railroads, ship railways, and the appliances of each and all, are largely noticed.

Bridges.—This item has become, since the introduction of steel as a material for bridge construction, a most important branch of engineering, and the competition between the large manufacturers has resulted not only in lessening their cost by reason of improved methods of dealing with the raw material, but in approximating toward the limit of economy in the structures themselves through a more scientific arrangement and adjustment of the parts. In fact, if any one subject more than another may be said to mark the present as the era of engineering enterprise, it will be found in the wonderful strides being taken in the plans and construction of great bridges and in the increased use of steel as a material. We refer (fully illustrated) to the great East River bridge and the details of formation and cable making; the Niagara suspension bridge, the Frith of Tay new bridge, the Forth bridge, the Pittsburgh suspension, the Albany bridge, the great Kentucky River bridge in detail, the Chaudière bridge details, the Ohio River bridge and designs generally of long-span iron bridges for railways, and notes of lesser structures and the various improvements in the application of metal work, and to reviews of books treating the subject of bridge building.

Tunnels.—Under rivers, such as the Hudson River Tunnel, with details of progress, proposed Dover, Ariberg, Simplon, St. Gothard, and kindred operations on less extended scale, such as tunnel railways in cities, etc., due mention has been made.

Canals.—Erie, Illinois and Michigan, Isthmus of Corinth proposed, Panama, with discussions and criticisms, the Welland and Lachine canals, notices of writings on the subject, and improved methods of movement thereon, Holland canals and dykes, crib works, public works of India drainage canals, dry and wet docks, have been considered as kindred in character of work, and bearing on inland navigation;

Improvements of Rivers and harbors by the U. S. Government, the Mississippi, as also the levee system, the jetty system, the calculation and utilization of river currents have been considered.

Electric and Gas Lighting, with their defects and benefits, a subject of growing importance in which our country is taking the lead.

Water Supply and Works.—The history and statistics embracing cost, method of operation and financial success, of one hundred and seventy of the water-works of the towns and cities of the United States, is a valuable series of papers, while the adjuncts of city water supply, such as pumping engines, pipes, and their flow, proposed methods of preventing waste, water meters, reservoirs, cost of mains, cost of water as power in this country, the impurities of various city supplies, artesian wells as a city supply, list of cities and towns supplied by artificial works in this country have been considered at length.

Sewering and Draining.—The growing attention to all matters bearing upon the public health will be found to have received its due notice. The various systems of sewering and their comparative advantages and applicability to different localities, have been enlarged upon, and will, in the future, be fully discussed; as without *health*, the costly improvements with which we surround ourselves will lose much of their value, and certainly a large share of the comfort to be anticipated from them.

Steam Engine.—Under this head will be found much matter of information, such as boilers, furnaces, and the many adjuncts to the steam engine and its varied modern applications, besides notices of valuable papers on the subject.

There are many other subjects relating to city improvement and matters of general interest to engineers which do not admit of classification, notice of which is omitted here, but which a glance at the index to this number will show have not been lost sight of, and will evidence the pains taken to furnish engineers with professional news.

Elementary articles have been avoided as much as possible, as the scope of the journal is avowedly *practical*, and the engineer does not look to a weekly publication for the A B C of his profession.

It will be seen by the above that our labors have been largely and necessarily eclectic in the interest of our readers. What of original matter is furnished by ourselves will be regarded but as the cement which binds the whole edifice together, for, however good this may be, no one thinks of constructing the entire building of it.

ON PROBABLE ERROR.

BY MANSFIELD MERRIMAN, PROFESSOR OF CIVIL ENGINEERING IN LEHIGH UNIVERSITY.

When a quantity is measured several times with precision, the separate results will be found to disagree, owing to the impossibility of avoiding small errors of measurement. If the observations are made with equal care, or have, as we say, equal weight, there is no reason why one of them should be preferred to the other, and their average or arithmetical mean will furnish the most probable value of the quantity as shown by the measurements. The words "most probable value" are used to mean that value which the mind regards as most reliable, or as nearest to the true value, or it is the value in which one has the greatest degree of confidence, and upon which one would prefer to wager money if it were a question of wagers. For example, suppose the length of a certain table is to be determined; one measurement gives 4.328 meters and another gives 4.322 meters, and if they are of equal reliability or weight the most probable value must be half way between them, namely, 4.325 meters, or their arithmetical mean. If a third measurement be made giving 4.331 meters, the arithmetical mean of the three becomes 4.327 meters, which is now the most probable value instead of 4.325. Whatever be the probability or degree of confidence placed in 4.325 that placed in 4.327 should be higher, for the expenditure of time, care and money required to deduce the latter is greater by one-half than that required to deduce the former, and thus in general the probability attached to any result, which is the mean of several observations of equal weight, increases with the number of measurements. The greater the number of measurements the higher is the probability of the mean; that is to say, the greater is our degree of mental confidence that it nearly approaches the true value of the quality sought.

The degree of probability to be ascribed to a mean of several observations also varies with the care and precision taken in doing the work. This will be shown by the agreement between the results of the individual measurements. For instance, let an observer measure an angle five times with a theodolite reading to five seconds, and again

with a transit reading only to minutes. Suppose the result to be the following :

By the theodolite.			By the transit.		
46°	28′	25″	46°	28′	00″
46	28	20	46	20	00
46	28	25	46	28	08
46	28	30	46	28	30
46	28	25	46	28	00
Mean = 46	28	25	Mean = 46	28	18

Here the mean 46° 28′ 25″ is the most probable value for the theodolite observations, and the mean 46° 28′ 18″ is the most probable value for the transit observations, but every one will recognize that the reliability of the latter is much less than that of the former. The individual readings of the theodolite differ from the mean only 5″ at the highest and between themselves 10″ at the highest, while those of the transit differ from the mean as high as 42″ and between themselves as high as 60″. These differences alone, if we knew nothing about the precision of the two instruments, would tell us that the reliability of the first set of observations is far greater than that of the second.

The probable error is a quantity which shows the degree of probability or reliability of an observed quantity as deduced from the agreement of the measurements among themselves. An *error* is deviation from the truth. The *probable error* is an error of such a magnitude that the chance or probability of the observed quantity being less than that amount from the truth is equal to the chance or probability of being more than that amount from the truth. For instance, it can be shown that the probable error of the mean of the above theodolite observations is one second, and it is an even wager that 46° 28′ 25″ lies within 1″ of the true value of the angle or that it does not. And in such a case it is usual to write the probable error after the mean with the ± sign between them, thus

$$\text{Theodolite mean} = 46^\circ\ 28'\ 25'' \pm 1''.$$

It may also be shown that the probable error of the mean of the above transit observations is eight seconds, and we write

$$\text{Transit mean} = 46^\circ\ 28'\ 18'' \pm 8''.$$

It will hence be seen that the amount of the probable error indicates the degree of reliability to be placed in the mean. The less the probable error, the greater is the precision of the observations and the confidence we can place in the mean. Thus we could afford to make an even wager that the theodolite mean lies within 1″ of the truth, while for the transit mean we could only lay the same wager that it lies within 8″ of the truth; our confidence in the theodolite mean is then, we may say, eight times as great as in the transit mean, or its degree of precision is eight times as much.

The deduction of the rules for computing probable error may be found in books on the Method of Least Squares. The following is the rule for the most common case, namely, for that of the mean of several measurements of equal weight made upon a single quantity :

1st. Add together the several measurements and divide by the number of measurements, thus obtaining the arithmetical mean or most probable value.

2d. Subtract each measurement from the mean and thus obtain the differences, about half of which will be positive and the other half negative.

3d. Square each of these differences and take the sum of the squares.

4th. Divide the sum of these squares by the number of observations and this quotient by the number of observations less one, and take the square root of the result.

5th. Multiply this by the decimal 0.6745 and the product will be the probable error of the mean.

In the shape of a formula this rule may be more simply stated. Let N be the number of observations, D one of the differences obtained by subtracting a measurement from the mean, and SD^2 the sum of the squares of all these differences, then

$$\text{Probable error of mean} = 0.6745\sqrt{\frac{SD^2}{n\,(n-1)}}$$

The following example will show the application of the method. The distance between the two fixed points was measured seven times with a tape line and the values found as given in the first column of the following table. Required the mean and its probable error.

Feet.	*D*	D^2
399.05	+0.10	0.0100
399.19	−0.04	0.0016
399.17	−0.02	0.0004
399.23	−0.08	0.0064
399.13	+0.02	0.0004
399.03	+0.12	0.0144
399.25	−0.10	0.0100
mean = 399.15		$SD^2 = 0.0432$

The sum of the seven measurements divided by seven gives 399.15 for the mean. In the second column, headed *D*, are given the difference between the mean and the measurements, and the third column gives the squares of these differences. The sum of these squares is 0.0432. This divided by 7 and then by 6 gives 0.00109, whose square root is 0.0321. The product of this by the abstract decimal 0.6745 is 0.022, which is the probable error of the mean. We may then write as the final result:

$$\text{mean} = 399.15 = 0.022 \text{ feet.}$$

It is then an even chance that the true length of the line lies between the true limits

$$399.15 + 0.022 \text{ and } 399.15 - 0.022$$

that is between 399.172 feet and 399.128 feet, or that it lies outside of those limits.

It should be carefully noted that the mean and its probable error to be reliable must be deduced, not only from precise measurements, but from measurements where every care has been taken to exclude errors of a constant nature. If, for instance, the tape line in the above example is too long or too short that error will appear also in the mean. Mathematical theory of probability, in short, from which the method of probable errors is deduced, deals only with accidental errors of observation, namely those that are unknown and supposed to be governed by no laws but those of chance.

The theory of errors teaches that all observations are approximate, that we never can determine the exact numerical measure of a quantity, and that the best that we can do is to find a result more or less probable to be used instead of the true value, for the case discussed in this article the method of least squares shows that the arithmetical mean gives the most probable value. But it is not sufficient for those who are to use this mean that it be merely given without any statement of its degree of reliability. For all precise observations the probable error should be stated that a clear mental idea may be formed of the probability and reliability of the mean, and that it may be properly used in connection with other results of the same kind.

THE IRON TRADE.

[Prepared specially for Engineering News.]

Reports from all the leading iron and steel producing and market centers at home and abroad confirm the statements heretofore made in these columns as to the remarkable activity in the making of iron and its multiform products. From private correspondence had with most of the large manufacturing firms, especially of construction iron and iron used in heavy engineering work, it appears that there is a greater volume of work projected, contemplated and uncompleted than ever before. The leading item following railway construction is bridge building. Manufacturers of structural iron have, in a general way, orders sufficient to carry them at full capacity over the winter and into April. The work in hand is for distribution all over the country. Since December 1 there has been a gradual accumulation of inquiries and orders, many of which come from railway companies in the Southern States. Recent reorganizations and changes of management have infused new life into railway construction, and bridge works are feeling the benefits in orders, which at present rate of progress promise to overcrowd productive capacities early in the present year. In anticipation of an extraordinary demand considerable capacity is being added. The projected construction of not less than 20,000 miles in the United States and Mexico, not including fresh enterprises constantly coming into notice, will require all the iron which our mills can produce, and probably more. A second factor not to be overlooked in estimating the probable course of construction iron next year is the enormous amount of house-building, large storehouses, manufactories, depots, etc. The question for manufacturing interests to consider is the present and prospective capacity to make iron sufficient to meet the probable requirements. That they will exceed the requirements of last year by 30 per cent. is not questioned by those who know. No mills were idle in 1881, but single turn prevailed and output was restricted during the first half of the year to suit demand.

The merchant bar mills were caught napping, so to speak. The same fate may possibly be in store for the manufacturers of structural iron and plate and tank, wrought and cast pipes and tubes. A fan-like tail of improvements is following the building of railroads. Towns are springing up, older towns and cities are expanding in growth and wealth, and engineering works are being propelled with a corresponding vigor. The columns of our class journals exhibit to some extent the degree of enterprise let loose. Manufacturers of finished and crude iron are now on the *qui vive* lest their failure to forecast events should precipitate enormous supplies of foreign iron and depress the market. It is time that violent fluctuations in the iron trade were terminated. It is not easy to make too much of such an article in this decade. Spurts of activity have followed seasons of extreme depression. Prices have sunk to bankruptcy limits, and then leaped to limits which barred enterprise and repressed activity. The excuse in the past has been uncertain tariffs and the dread of importations. Contemplated legislation on the one hand, and great industrial activity abroad on the other, are acting to remove these causes.

Engineering enterprises of unprecedented magnitude are looming up.

Steady iron markets and moderate prices are essential to the prosecution of enterprises, great or small. The inflation of values between 1869–1873 helped to terminate that era of activity. That error is not being committed. Prices are kept within moderate limits, but an advance which would dissuade capital and enterprises is no more impossible now than then. There are no causes for apprehension as to the future. American enterprise has demonstrated its ability to deal in a masterly manner with all issues, problems and difficulties. No doubt the possible dangers hinted at are seen by some, and preparations are being made for their circumvention. An enhancement of prices attracts less skillful management into business to increase the force of competition in seasons of moderate activity.

Blast furnaces have in general about two months product sold, and prices are at a point which is leading to negotiations with foreign holders. Merchant iron makers are well sold up and are taking all orders presented subject to market changes. Orders for railway material are constantly going abroad because of the difficulty of obtaining deliveries. Nearly all blast furnaces are in blast that can run. New mills are going up and additions are being made to old ones. The iron trade enters on 1882 under better auspices than was ever before its good fortune to have.

PERSONAL.

MR. SELAH CHAMBERLAIN, a Cleveland contractor, has just been paid $200,000 in cash and $2,000,000 in new 4½ per cent. bonds, by the State of Minnesota, the conclusion of a legal fight of nearly twenty-five years' duration. Mr. Chamberlain brought away his magnificent fortune in a special car, which was well guarded from St. Paul to Cleveland. The American Express Company charged $3,500 for transportation to Cleveland, which Mr. Chamberlain thought was exorbitant, so he took his own method and risk.

DR. JOHN W. DRAPER, the eminent scientist, died at his home at Hastings-on-the-Hudson on the 4th. He was born at St. Helens, near Liverpool, England, May 5, 1811.

COLONEL W. C. MELVIN, Civil Engineer in charge of the government works at the mouth of Tone's Bayou, Red River, died suddenly at Shreveport, La., on the 3d, it is supposed of heart disease.

CONRAD HERBERT, superintendent of the La Fayette (Ind.) water-works, has resigned.

MR. ROSWELL SMITH, publisher of *The Century*, has just performed a generous act, rare indeed in the annals of business. He not only gave $5,000 in Christmas gifts to those whom he employs, but distributed among the leading members of his literary and business staff $16,000 in *Century* stock, a stock which, as has already been stated, is exceedingly valuable.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 520, Vol. VIII.*)

CLXX.—BRIDGETON.

Bridgeton, New Jersey, in lat. 39° 31′ N., long 75° W., is on both sides of Cohansey Creek 37 miles south of Philadelphia, in a gently undulating region. The town was settled in 1754, incorporated as a borough in 1858 and as a city in 1865.

Water-works were built by the city in 1877, after the plans and under the superintendence of Isaac S. Cassin, C.E., taking the supply from East Lake, a natural pond of 30 acres area within the city limits, the ordinary flow of which affords a valuable water power. The overflow from the lake is impounded in a retaining reservoir holding 3,000,000 gallons, and is pumped thence by a compound duplex Worthington pump of 1,000,000 gallons capacity, through 2,300 ft. of 16 in. cast-iron pipe, into a reservoir built in excavation and embankment on a hill 108 ft. above the Cohansey, 88 ft. above the lower reservoir and a mile from the city. The reservoir is 135 ft. square, 15 ft. deep, and is in two divisions. Distribution is by cast-iron pipe, of which 10.63 miles of from 16 to 2-in. diameter, 2 miles being less than 6 in. diameter, were in use in December, 1880, with 72 fire hydrants and 392 taps and 2 meters. Galvanized iron service pipes are used. A 16 in. submerged pipe crosses the river. The population in 1880 was 8,729 and the daily consumption 168,208 gallons.

The works have cost $79,070 50 and the bonded debt is $76,500, bearing 6 per cent interest.

The city pays to the water fund $38 per year for

each fire hydrant. This amount is included in the receipts in the following statement:

	Expenditures.			Receipts.
	Construction.	Interest.	Maintenance.	
1878	$71,033.42	$3,480.94	$1,209.17	$1,616.45
1879	5,204.68	4,117.17	1,388.53	5,408.70
1880	2,832.40	4,440.00	1,494.81	6,831.80

The superintendent of the water-works, Timothy Woodruff, reports to the water committee of the Common Council.

CLXXI.—ROCKFORD.

Rockford, Illinois, in lat. 40° 18′ N., long. 89° 10′ W., is on both sides of Rock River, which at this point is crossed by a dam 6 ft. high furnishing a water power used for manufacturing.

Settled in 1834 it was incorporated as a city in 1852. Water-works were built by the city in 1875 after plans furnished by the Holly Manufacturing Co., taking water from the river and pumping it directly into the main by Holly engine and four double-acting piston pumps of 9 in. diameter and 24-in. stroke. In the inlet pipe from the river there is a filter 25 ft. in diameter, filled with sand and charcoal, which passes 800,000 gallons of water per day, but does not work satisfactorily. A well 50 ft. in diameter and 45 ft. deep was also sunk in water-bearing gravel, which is said to be capable of yielding 1,500,000 gallons per day. Distribution is by cast-iron pipe of which 27 miles are in use, of from 20-in. to 2-in. diameter, with 190 fire hydrants and 1,000 taps. Wrought-iron pipe and lead pipe are used for service pipe. The mains on the opposite sides of the river are connected by 680 ft. of submerged 12-in. pipe, with 13 flexible joints

The population in 1880 was 13,136, and the daily consumption 900,000 gallons. The ordinary pressure maintained is 57½ lbs. and the fire pressure from 95 to 110 lbs.

The cost of the works has been $280,070.44. The expenditures in 1880 were $5,791.76 and the receipts $7,273.78.

The works have been managed since their construction by S. P. Crawford, Chairman of the Water Committee of the Common Council. John A. Ferguson is the Chief Engineer.

CLXXII.—NEWPORT, R. I.

Newport, Rhode Island, in lat. 41° 29′ N., long. 71° 19′ W., on Narragansett Bay, is on the summit and slopes of a hill on the south part of the island of Rhode Island.

Settled in 1639, it was incorporated as a city in 1784. Water-works were built in 1875 by George H. Norman, and were owned by him alone until June, 1881, when a company was organized. Water is taken from Easton's Pond, formed by impounding the water of 4½ sq. miles watershed, by two dams of sand, one 2,800 ft. long, 15 ft. high and 12 ft. wide at top, with the water-slope covered with rip-rap stone; the other 2,000 ft. long, 4 ft. high and 6 ft. wide on top. The area of the pond is 160 acres. From the pond the water is lifted 160 ft. into a reservoir of 10,000,000 gallons capacity, built in excavation and embankment, with its flow-line 60 ft. above the highest point in the city. There are two steam pumps, a "Knowles" of 19½-in. water cylinder and 36-in. stroke, and a "Carr-Selden" of 12-in. water cylinder and 24-in. stroke.

Distribution is by cast-iron pipe and some wrought-iron and cement pipe. About 30 miles are in use of from 18-in. to 4-in. diameter, with 157 fire hydrants, 113 gates, 1,160 taps and 27 meters. The city pays for the use of water for fire hydrants. The service pipes are of wrought iron, cement lined. The population in 1880 was 15,693. The daily consumption in 1881 was about 500,000 gallons. The capital stock of the company is $500,000. Statistics of cost and revenue are not furnished. Charles B. Weaver is the superintendent and treasurer, and G. Cole Stevens the clerk.

CLXXIII.—NORRISTOWN.

Norristown, Pennsylvania, in lat. 40° 7′ N., long. 75° 15′ W., is on the Schuylkill River, 16 miles above Philadelphia. The topography is hilly. Settled in 1778, it was incorporated as a borough in 1812.

Water-works were built by a private company in 1847, after the plans of William E. Morris, C.E., taking the supply from the river, which opposite the town is divided by an island a mile long, and from the further channel a conduit 20-in. diameter and 1,450 ft. long conveys the water to the pumping station, where it is lifted by three steam pumps, one of 7⅞-in. bore and 60-in. stroke, a double-acting piston pump, one a Worthington duplex pump, of 1,000,000 gallons capacity, and the third a double-acting piston pump, of 16-in bore and 16-in. stroke, built by R. S. Newbold & Son, into two reservoirs, one 194 ft. above the river, and of 10,000,000 gallons capacity, the other 132 ft. above the river, and of 750,000 gallons capacity. Both are in excavation and embankment, in two divisions, and with the inner slopes lined with brick pavement on clay puddle.

Distribution is by cast-iron pipe of 16 in. to 3-in. diameter. The pumping main is 1⅞ miles long, of 24-in. diameter; 27 miles of pipe are in use, with 85 fire hydrants, 125 gates and 2,500 taps. The town does not pay for use of hydrants. The population in 1880 was 13,863 and the daily consumption 800,000 gallons. The capital stock of the company is $150,000. The works have cost $275,000. The bonded debt is $90,000, at 5 per cent. interest. H. S. Sechler is Secretary of the company and John Slingluff the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From Timothy Woodruff, Superintendent, reports of Bridgeton (N. J.) water-works for 1878, '79, '80. From the Water Commissioners, report of Erie (Pa.) water-works from May 1, 1879, to Dec. 31, 1880. From Geo. P. Wescott, Superintendent, history of the Portland (Me.) Water Company. From John A. Ferguson, Chief Engineer, statistics of Rockford (Ill.) water-works. From John Slingluff, Superintendent, statistics and water rates of Norristown (Pa.) water-works. From G. Cole Stevens, Clerk, statistics of Newport (R. I.) water-works.

SYLVESTER'S TIDE AND CURRENT BREAKERS.

The attention of our readers is called to the above engraving which represents a tide and current breaker that has been used during the past six months in the channel of the Piscataqua River, Portsmouth, N. H., for retarding the current while removing rock.

The velocity of the current in this river at this locality, whether at ebb or flood tide, is from four to six miles per hour, and the time of slack tide is so brief that it became a doubt whether the ledge known as Gangway Rock, which was in the channel and covered with twenty-two feet of water at high tide, could ever be removed.

The work is now being successfully done by the use of "Sylvester's Tide and Current Breakers," which retard the current to such extent as to make comparatively still water under the lee of the breakers, and a submarine diver is enabled to perform in safety any required work at all times.

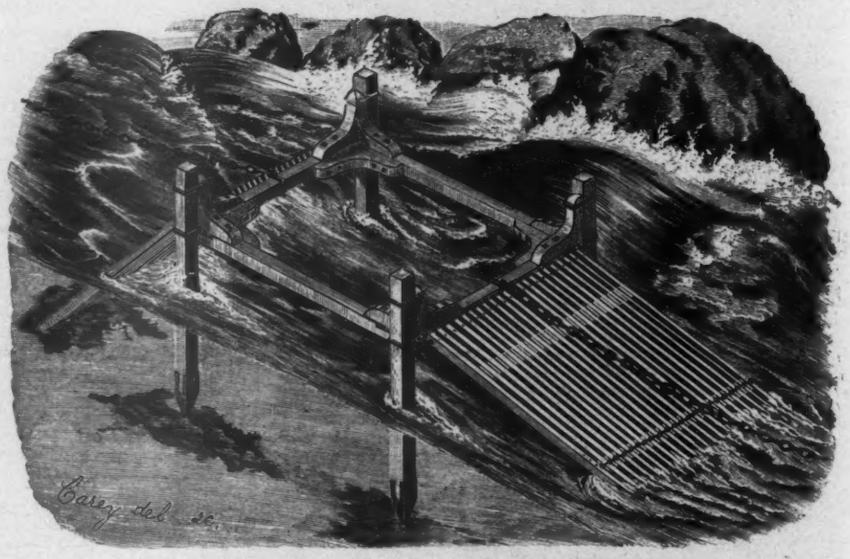
The tide and current breakers, or the direct agent that retards the current, consists of a series of timbers that rise and fall at each end of the frame, according to the direction of the current. These timbers are uniformly spaced so that a sufficient quantity of water may pass through them, and the water that has been rendered turbid by the disturbance of the soft material on the bed of the channel is made perfectly clear.

In whatever direction the currents may be, the breakers on the end from which the current is running will be forced down until they rest on the bed of the channel, and the breakers on the opposite end will float on the surface of the water, as seen in the engraving.

In currents of very swift velocity the frame with the breakers may be anchored, though under ordinary circumstances this is not necessary, as its weight keeps it in position.

Our readers will see the utility of this invention in any swift current where work without it would be impossible; not only for removing rock, but for building and repairing dams, removing obstructions and other work where the hours of labor are limited by the current or changes of the tide.

This invention was patented August 23, 1881, and parties wishing particulars in regard to any of its details, or general information, may address Isaac A. Sylvester, Newton Centre, Mass.



SYLVESTER'S TIDE AND CURRENT BREAKER.

SAND FILTRATION AT BERLIN.

BY PROF. WILLIAM RIPLEY NICHOLS.

[From the Journal of the Franklin Institute.]

Up to the present time there has been very little done in this country in the way of systematic filtration of water supplies, partly, perhaps, from indifference and lack of information, but mainly on account of the expense. The numerous complaints which arise in the case of almost every city and town supplied with surface water render the question of filtration an important one for the immediate future, and any engineer who has to do with the planning of water-works is liable to be called upon to estimate the cost of filtration and to state how far it may be expected to overcome anticipated or existing evils. For this reason, details of the practice in well-managed works, where the conditions are similar to those which obtain with us, are of peculiar interest. Such details are given in a pamphlet recently published by the superintending engineer (Betriebs-Ingenieur) of the Berlin filtration works. The pamphlet also contains the results of observations on "natural filtration" in the neighborhood and elsewhere.

A very considerable portion of the city of Berlin is still supplied with water from the dirty and sluggish Spree after it has been subjected to a very thorough filtration. The water is taken from the river directly on to the filter-beds, and although the sluggishness of the flow would allow the deposition of much suspended matter, the very considerable water traffic between Berlin and Köpenik, past the water-works, keeps the water in a roily condition. Furthermore, the Spree receives, above the point from which the supply is taken, the waste-water of a number of factories, among which are dye and print-works, it also receives the effluent of a sewage farm, mixed, in some cases, with sewage itself. Besides being thus contaminated, the water, especially in time of flood, possesses a deep brownish-yellow color and, at times, a peculiar *pondy* taste, due to vegetable extractive matter. Moreover, from spring until fall, a more or less copious growth of *algæ* adds to the disagreeable character of the water.

The filtration works now supply daily about 40,000 cubic meters (in round numbers 10½ million U. S. gallons) of filtered water—in summer often a larger quantity. There are eleven filter-beds—three covered and eight uncovered—having a total area of 37,000 square meters (about 400,000 square feet). The beds are constructed on the English model, fine sand at the top and coarser material below. With the large area at disposal it is possible to carry on the filtration at a very slow rate. The water is used, of course, in varying quantities from hour to hour, and, on account of the small size of the clear water reservoir, a constant rate of filtration is impossible; the maximum rate is, however, not over 4 inches downward per hour

For the greater part of the time 10 square feet of sand surface is not required to furnish much more than 35 cubic feet of water in twenty-four hours. This would be at the rate of only 24½ U. S. gallons per square foot, and very much less than is the practice elsewhere. The filtration takes place under a very slight head, seldom of more than 20 inches, but even with this low pressure and slow delivery it has been found impossible, with clean sand alone, to filter the water satisfactorily. If the unfiltered water be allowed to stand a fortnight or so, although the larger of the suspended particles will have settled to the bottom, the water still retains a milky appearance, and sand alone cannot remove the exceedingly fine particles to which this appearance is due. On this account, the water from a freshly cleaned filter is not used at once, but is allowed to stand on the bed and then passed through very slowly until a thin coating has formed on the surface of the sand. This coating is essential to the removal of the finest particles from the water subsequently filtered. Of course, as the coating becomes thicker the filtration becomes more difficult, until it partially stops and the filter is "dead."

As has been hinted above, the great trouble in summer is from the abundance of small *algæ*, which soon clog the filter. When the *algæ* are absent, 10 square feet of surface usually filters 700 cubic feet before cleaning is necessary, but in summer the capacity is not over 350 cubic feet to the same area. Sometimes the meteorological conditions are such, especially late in the season, that the *algæ* enter into decay and form a peculiarly slimy and almost impervious coating over the surface of the sand, so that it becomes impossible, under the pressure commonly employed, to pass more than 70 cubic feet of water through 10 square feet of sand surface. This decomposition of the *algæ*, as described by Piefke, has often been noticed in the ponds and reservoirs of the Eastern and Middle States, and the very particular observations which Piefke gives on this point are well worth the attention of any who are called upon to consider the question of filtration in this country. We may note the fact that under the conditions just referred to, the superiority of the covered beds became very evident. As has been observed in this country, the decay of *algæ* increased very much the amount of ammonia (of "albuminoid ammonia") and of nitrites and nitrates. A rather curious observation was made in the decomposition of the *algæ* on the open filter-beds. The gaseous products of decay collected in bubbles until these were sufficiently large to break through the slimy coating and rise to the surface. In the hot days of August this evolution of gas was very considerable, and, as a result of this piercing of the coating, a "dead" filter was sometimes brought again into activity; when such a filter was cleaned the little cavities in the sand thus produced were clearly defined, filled, of course, with accumulated dirt.

The *algæ* are not to be regarded as an unmitigated evil. Besides making the removal of the finer portions of the sediment possible, in their growth they are purifying agents; they change at least a part of the dissolved organic matter into insoluble substances which settle to the bottom and can be removed by filtration. It is, however, desirable that the water should not remain in contact with them after they have begun to decay.

If, after filtration, the apparently perfectly clear Spree water is allowed to stand for eight or ten days green *algæ* develop themselves, which is probably due to the fact that the spores of the plants are not retained by the filters. This fact, however, is of no practical consequence in the case of the Spree water, for the water is consumed long before the spores have had time to develop. This is not the case with all waters, as has been found by experience in the works which supply another portion of Berlin. The "ground water" of the Tegel supply contains an *alga*, the *crenothrix polyspora*, of such rapid development that filtration would not be of much use, as the unremoved spores would develop in the service pipes before the water was consumed.

As has been mentioned, the Spree water often possesses to a marked degree the brownish-yellow color common to streams which flow through marshy or peaty regions and to the water of most impounding reservoirs. This color, with the taste which at times accompanies it, gives rise to general complaint, but even very slow filtration fails to remove it to any considerable extent. Filters of finely-prepared cellulose remove a large proportion of the color, but are hardly practicable on the large scale. If sand filters have a slight action in this direction, it is to be ascribed rather to the sediment containing vegetable fiber than to the sand itself.

A few pratical details of mananement may be of interest. In the Berlin beds the thickness of the sand is 600 millimeters (about 2 ft.). At each cleaning the sand is removed for a depth of about 10 millimeters, but fresh sand is not returned to the bed until only about 200 millimeters of the original thickness remain. The foul sand is allowed to stand exposed to the air until, by decay, the organic matter has lost its slimy character; it is then washed and eventually replaced upon the beds. When the filters are emptied the water is drawn completely off, and by successive and systematic stirring nearly the entire thickness of the sand is exposed to the air in order that the small amount of organic matter which was not retained at the surface may be oxidized and destroyed. With the same object in view, the air is allowed to circulate freely, for several days if possible, through the coarser underlying material. The filters are filled from below with filtered water, and then the water is passed through slowly and is allowed to waste for several days.

Artificial filtration is, on the whole, not a difficult operation, but it is one in which the details must be conscientiously and intelligently attended to, and there is no room for negligence or false economy. That the beds must be often cleaned, that from time to time a few thousand cubic meters of filtered water must be used in refining the beds; these are matters of no consequence if it is thereby possible to reach the main object in view—namely, the furnishing of a good water. The place for economy is in the choice of the cheapest way of carrying on the various details of the works.

Piefke also describes experiments on the use of iron as a purifying medium as a preliminary to sand filtration, but the experiments did not awaken hopes that iron could be used advantageously on the large scale.

AMERICAN SOCIETY CIVIL ENGINEERS.

At the regular meeting of the Society, held on Wednesday evening, the 4th inst., the following were elected:

FOR MEMBERS:

ONWARD BATES, Civil Engineer, Dardenne, Mo.

WILLIAM WINGFIELD BONNYN, Civil Engineer, Montreal, Canada.

SAMUEL M. FELTON, JR., Gen. Supt. Pittsburgh, Cincinnati & St. Louis R. R., Columbus, O.

CHARLES E. GREENE, Chief Engineer Extension Toledo & Ann Arbor Railroad, Professor of Civil Engineering University of Michigan, Ann Arbor, Mich.

THOMAS W. JAYCOX, City Engineer, Leadville, Colo.

MIRTILIANO SICARD, Civil Engineer, Ibagué, U. S. of Colombia.

FOR ASSOCIATE:

GEORGE HENRY FROST, Civil Engineer, ENGINEERING NEWS, New York City, N. Y.

FOR JUNIORS:

JAMES PETER BOGART, Engineer Connecticut Shell Fish Commission, New Haven, Conn.

ARTHUR HAVILAND, Assistant Engineer Tehuantepec Inter-Ocean Railroad, Jaltipan, Mexico.

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

THE regular weekly meeting of the Polytechnic Association, a branch of the American Institute, was held Thursday evening, Dec. 15, the President, Mr. Stetson, in the chair.

Mr. Keith read the rules lately put in force by the Board of Underwriters of New York City in regard to the manner of putting in electric light apparatus to buildings in this city to avoid danger from fire. The rules go to an extreme of caution. Mr. Keith explained that the electric light companies already largely exceed the required conductivity, 50 per cent. excess. The smallest, even with the arc system, is No. 8 wire. It conducts the current without being appreciably raised in temperature. Heat is generated in a conductor when it is too small to carry the current freely. No. 16 is large enough. It will only raise the temperature to about 110 degs. Fah. With the incandescent system most companies use larger wire, up to No. 3. These wires are a fourth of a square inch in section. The electric resistance of a small wire absorbs and wastes power which otherwise would show itself as light at the lamps.

The case was analogous to passing water through pipes. A small pipe requires more head or force to cause the passage of a given quantity of steam, or any fluid, in a given time, and the working pressure at the delivery end is reduced by the wire-drawing.

Mr. Keith averred that the brick, or plaster walls and ceilings of a building are as good insulators as any insulating substance which can be put around the wires. Dry wood is nearly or quite as good. He thought there was no advantage worth considering in an insulating covering for wires on the ceilings; but such was important in places upon the floors or walls where there is a liability of some conducting substance touching both the inlet and the outlet wires.

Where the positive and negative wires run near together they should be well covered by some non-conducting substance, which will absolutely prevent accidental contact with both at one time. The rules were sound on that.

There is not a particle of danger in touching one wire with any substance at any place. All thought the practice of returning the current by the earth, or by connections to water or gas pipes, should be absolutely prohibited. Doing so makes all conducting substances in connection with the earth a return conductor.

Mr. John W. Sutton opened the regular subject, measuring power. There were two general systems. One extinguished the power it measured by friction induced for the purpose, and could only be used a short time as a test. The other measured without much retarding, and could in theory be used all the time.

The horse-power of engineers' parlance is a little more than an average horse can do steadily ten hours a day. It is thirty-three thousand foot-pounds per minute. It is 550 pounds lifted one foot high each second.

The De Prony brake, familiarly known as the "pony," was drawn on the blackboard and explained with a modification employed by the American Institute. A lever is clamped upon the shaft or upon a smooth pulley thereon with just sufficient force, and the weight of the lever and of anything hung thereon which is lifted by the friction gives the resistance. This must be multiplied by the speed, making due allowance for the leverage to get the equivalent of the number of pounds per minute lifted one foot high.

On the transmission system, Mr. Sutton's favorite dynamometer was a pulley connected to the shaft by springs, with delicate devices for observing while running exactly how far the springs were deflected to know the strain in pounds, which being multiplied by the velocity in feet per minute, gives the number of foot-pounds per minute.

For a crude measurement a belt just able to do the required work without slipping could, with cheap apparatus, be made a test of power. Find by repeated trials just how much strain on a lever of a given length will slip the belt when the machinery is stopped, and we have the strain under which the belt is acting while in use, which, multiplied into the speed, gives the power.

Mr. N. S. Keith described and drew the Kent dynamoner, a Pittsburgh invention, used at the Stevens Institute, at Hoboken. The power is communicated from one gear-wheel to another through a loose gear-wheel, which of course tends to move bodily with twice the force communicated. This tendency to move is measured very accurately by mounting it on a weighted lever, hung pendulum fashion; the sine of the angle of inclination assumed, gives the equivalent of a horizontal lever supporting an equal weight.

The machine at the Hoboken Institute was very well made by the students themselves as a part of their education. The driving shaft was in line with the driver, each having a similar bevel-wheel, face to face, a sufficient distance apart to allow the pendulum lever and the bevel-wheel thereon to work between them. To reduce the strain on the central point of the pendulum there were two bevel gear-wheels on that lever, one on each side of the center. Both served to communicate the dynamic effect from one shaft to the other, and both contributed to deflect the heavy pendulum so as to measure exactly the strain communicated.

PREVENTING THE BURSTING OF WATER PIPES THROUGH FROST.

In a short paper recently read before the Physical Society in London, a method patented by Powell, Rigby & Co. was referred to, by which the bursting of water pipes by frost may be prevented. The proposal is to use pipes of an elliptical or other than round section. As the sectional area of an elliptical pipe is less than that of a round pipe of equal perimeter, it is obvious that when the inclosed water freezes and expands the section of an elliptical pipe will more nearly approach a circle. There is more, however, in the idea than at first sight appears.

When the water in a round pipe freezes, and the pipe begins to stretch at any point, it becomes both larger in diameter and thinner there than elsewhere; each of these effects causes the pipe to be still weaker at the place effected; therefore, a round pipe is in a state of unstable equilibrium. With elliptical piping the case is different. The force required to alter the shape of an elliptical pipe increases as its section changes from the elliptical towards the circular; therefore the effect produced by a change of shape at any place makes that place stronger. An elliptical pipe is, therefore, in a state of stable equilibrium, and will change its form uniformly from end to end. This fact is of great importance, as if a portion only of a pipe is exposed to the cold the whole is effective, and it will require a proportionately greater number of frosts to make the pipe round. An inspection of the pipes every two or three years will give absolute security, for as soon as

they show signs of becoming round they can be squeezed back again to their original section. Experiments have confirmed in every detail these theoretical deductions.—*Com.*

LITERATURE.

Steam Heating for Buildings, or Hints to Steam Fitters. By WM. J. BALDWIN, Engineer. Illustrated. John Wiley & Sons, New York, 1881.

This is essentially a practical work on the gravity system of steam heating, as applied to all purposes, including cooking, washing and drying, with such reference to standard writers on the theoretical principles involved as are essential to the establishment of rules for practice, embracing all the details of the workshop and the fitting up, sufficiently illustrated as to enable the workman to design, lay out and complete, ready for operation, a steam-heating apparatus for any of the purposes for which steam heating is applied, and is so well written that we can only suppose the following to be accidental. He likens "the boiler to the heart; the steam pipes the veins, and the return pipes to the arteries; thus carrying heat and life into every part of a building." This, we think, is a little mixed; but it is not as a work upon anatomy that we recommend the book, but for its clear, practical elucidation of a subject, the literature of which has, up to this date, rather scant proportions.

Manual of Logarithmic Computations. By ALFRED G. COMPTON, A. M. John Wiley & Sons, New York, 1881.

If the simplicity of calculation by means of logarithms were taught at the time, or thereabouts, when we learned the multiplication table, it would be proved in after life a great saving of time and patience. If one is engaged in logarithmic computations daily, or so frequently that the practical operations of calculation become, as it were, intuitive, a book like this would not become a necessity, as the process of computation by logarithms is usually sufficiently explained for practical purposes in the introduction to all published tables of any respectability. But if references to such tables are made only at long intervals, as is the case with many persons, the uncertainty that accuracy has been secured by following the simple practical directions, not infrequently leaves a doubt upon the mind of such as have not been thoroughly trained in elementary mathematics, for the clearing up of which ready means may not be at hand, and it is this class of computors who are particularly indebted to such tables for shortening computations, and to whom we would recommend this little work, as containing the clearest and most concise explanations of any intricacy which may arise in such methods of computation with which we are acquainted, and it deserves a place as a text-book in every school—for, as above hinted at, the principles and uses of recognized methods of abridging lengthened computations cannot be taught too early in this practical age.

We are induced to call attention to this from the fact of having received lately for publication an extended paper from a professor of civil engineering in a Western university, not only impugning the generally received fact of logarithmic computations being shorter and simpler, than such as are more direct, but calling in question their accuracy as well! While Professor Compton does not refer directly to the possibility of such attacks, he yet incidentally meets the objections by explaining very concisely the process through which any degree of accuracy may be attained by their use, and the determination of the limit of error involved in any case, and which the computor can, at his option, modify to any desirable extent.

AMENITIES OF NEW YORK JOURNALISM.

The New York *World* excites itself quite needlessly over the question of its nominal ownership. We know of nobody who is specially interested in finding a tangible person or corporation behind that changeable entity known as the *World*, unless it be two paper manufacturing firms, who have found some difficulty in making due service of legal process instituted to recover unpaid debts. If the person who claims to have been President since 1876 of an alleged corporation owning the *World* will publish his name, address, and office hours, it might save time and shoe-leather to the lawyers' clerks and subpœna servers, but would hardly be an item of general interest. The *World's* gibberish about stock-jobbing advertisements may indicate the very modest value which it places upon the use of its own columns for such purposes, but is hopelessly irrelevant to the statements made in *The Times*. We think the *World* would have some difficulty in finding a stock-jobbing or other speculative person verdant enough to pay five hundred cents for the publication of sufficient proof that the *World* and its proprietor or director are equally destitute of character and principle. We have told the story of the Manhattan swindle to very little purpose if any one has received the impression that it was intended to warn a trustful public either against Jay Gould or his newspaper. People who think that either would scruple to act dishonestly or speak falsely are beyond the reach of any argument of ours.—*N. Y. Times.*

It is interesting to be assured by that precious humbug of a journal, the *Times*, that "it would be difficult by any new revelation of trickery or rascality to add anything to the well-established reputation of Jay Gould." Was it on this account that the nominal chief stockholder of the *Times* went on all fours the other day before Mr. Jay Gould to solicit from him a subscription of $25,000 in aid of a fund nominally raised by the *Times* as a gift to General Grant, on the interest of which while the principal lay in his hands this nominal chief stockholder of the *Times* is understood to have made a neat little foreign tour, in the course of which he did *not* pay his respects to the able London correspondent of the *World*.—*N. Y. World.*

THE CITY'S BULKHEAD WALL.

About the middle of last September the Dock Commissioners appointed General Newton and General Gilmore, of the army engineers, and Mr. W. E. Worthen, civil engineer, a Board of Consulting Engineers to examine the bulkhead wall now building by the department, and report whether or not it was good and suitable, and if not, how it could be made so.

This board sent their report to the Dock Department on the 28th ult., and it is very full and clear. They state that they have made thorough and complete investigation into the wall and everything connected with it, and have tested some of the processes of construction, the resistance of the piles, the slope of the walls—both old and new—and various other details.

The following is a summary of their conclusions:

There are no movements of the wall other than were to be expected in such a bottom. The movements have not in any way lessened the stability or durability of the wall, and there is no indication that they will do so.

All the woodwork in the wall is thoroughly protected against decay and against the ship-worm.

The new system of capping piles under water to bear heavy weights by placing upon them a bed of mortar inclosed in bagging is both effective and economical.

As a whole, the plan upon which the wall is at present built combines the necessary elements of strength and durability, is ample in its dimensions, is sufficiently safe against tipping, and so far has been well and faithfully built.

They recommend some slight changes, but nothing essential, such as cheapening the cost of the concrete by using natural cement instead of Portland cement, and placing more stone in front of the wall at its base in case any of such stone should be accidentally removed, and conclude their very complete and able report with the following:

"The present cross-section of the wall as designed by your engineer-in-chief we regard as founded on correct principles of stability and economy, and the modifications we suggest seem to us to improve it without changing the ideas characteristic of the plan."

This report is doubtless very gratifying to Mr. Greene, the Engineer-in-Chief of the department, who designed the wall and has superintended its construction, and also to the Commissioners, who approved his plans and ordered the work, and finally to the taxpayers, who have to foot the bills; and in view of this approval from the highest authority the various criticisms upon this wall which have appeared during the past few years would appear to be the work of either incompetent or interested persons.

NOTES.

WHEN THE PLUMBERS FIRST BEGAN IT.

The ordinances of the plumbers, approved by the Mayor and Aldermen of London in the thirtieth year of Edward III., ordain "that every one of the trade shall do his work well and lawfully, and that for working a clove of lead for gutters or for roofs of houses he shall take only ½d., and for working a clove for furnaces, belfrys and conduit pipes, 1d. Also, that no one for any singular profit shall engross lead coming to the said city for sale, to the damage of the commonalty, but that all persons of the said trade, as well poor as rich, shall be partners therein at their desire." There were many ordinances, both royal and municipal, in the fourteenth century for the sale of various commodities "at reasonable prices." The general standard of "reasonable" or fair price and profit was custom. Where the seasons, as in the case of food, or other circumstances made a customary price impossible, the local authorities or the central government itself intervened to prevent sellers from taking advantage of the necessities of buyers. There was abundance of self-seeking and greed of lucre, as well as of hypocrisy, in the mediæval world, but they worked not through competition but through combination; towns, guilds, companies, classes, grasping at exclusive privileges, monopolies and gains. Men pursued their prey, as it were, in troops and packs. What was sought was not the gain of individuals as such, but of communities, corporations, fraternities and orders.—*The Fortnightly Review.*

THE WEIGHT OF A MILLION DOLLARS.

In answer to an inquiry by Assistant Secretary French, the Government actuary, Mr. E. B. Elliott, has furnished the following information as to the weight of a million of standard gold dollars and that of the same number of standard silver dollars:

The standard gold dollar of the United States contains of gold of nine-tenths fineness 25.8 grains, and the standard silver dollar contains of silver of nine-tenths fineness 412.5 grains.

One million standard gold dollars, consequently, weigh 25,800,000 grains, or 53,750 ounces troy, or 4,479 1-6 pounds troy of 5,760 grains each, or 3,685.71 pounds avoirdupois of 7,000 grains each, or 1 843–1,000 "short" ton of 2,000 pounds avoirdupois each, or 1 645–1,600 "long" ton of 2,200 pounds avoirdupois each.

One million standard silver dollars weigh 412,500,000 grains, or 859,375 ounces troy, or 71,614.58 pounds troy, or 58,928.57 pounds avoirdupois, or 29 464–1,000 "short" tons of 2,000 pounds avoirdupois each, or 26 307–1,000 "long" tons of 2,240 pounds avoirdupois each.

In round numbers the following table represents the weight of a million dollars in the coins named:

Description of coin.	Tons.
Standard gold coin	13½
Standard silver coin	269¾
Subsidiary silver coin	25
Minor coin, five-cent nickel	100

NUTMEGS

Grow on little trees which look like little pear trees, and are generally not over twenty feet high. The flowers are very much like the lily of the valley. They are pale and very fragrant. The nutmeg is the seed of the fruit, and mace is the thin covering over the seed. The fruit is about as large as a peach. When ripe it breaks open and shows a little nut inside. The trees grow on the islands of Asia and tropical America. They bear for seventy or eighty years, having ripe fruit upon them all the seasons. A fine tree in Jamaica has over 4,000 nutmegs on it every year. The Dutch used to have all this nutmeg trade, as they owned the Banda Islands and conquered all other traders and destroyed the trees. To keep the price up they once burned three piles of nutmegs each of which was as big as a church. Nature did not sympathize with such meanness. The nutmeg pigeon, found on the Indian islands, did for the world what the Dutch had determined should not be done—carried these nuts, which are their food, into all the surrounding countries, and trees grew again and the world had the benefit.

THE GROWTH OF LONDON.

The extraordinarily rapid growth of London in recent years has become a source of some anxiety to the Metropolitan Board of Works, which finds it an almost impossible task to superintend the draining and lighting of the new districts, which now extend continuously to Turnham Green in one direction and to Ealing in another. On the Surrey side of the river Thames no less activity is shown by the builders, and Sydenham, Chiselhurst, Wimbledon and Peckham Rye are now joined to the metropolis. The multitude of new houses are chiefly of a kind to suit persons whose incomes are moderate, and many of them are constructed to accommodate two small families. French flats, however, are not in favor in England, although a few of them may be found in Edinburgh. While these extensive accommodations have been prepared for the middle classes of London, the dwellings of the laboring people have been greatly improved. The filthy, fever-stricken dens which used to exist in the vicinity of Drury Lane, Gray's Inn Road, Smithfield and Chelsea Hospital have been swept away, and on their sites immense tenement houses erected, in which respectable artisans can find cheap and comparatively comfortable homes.

U. P. R. CONSTRUCTION.—During the year 1881 the Union Pacific Railway Company has laid 328 miles of track in Colorado, Wyoming and Montana. The extensions represented by this mileage are as follows: Julesburg Branch, 151 miles; Denver and South Park branches, 26 miles; Utah and Northern Extension, 66 miles; Greeley, Salt Lake & Pacific Branch, 10 miles; Oregon Branch, 75 miles. These new lines bring the grand total of track owned and operated by the Union Pacific up to 3,748 miles. Passenger trains are not yet running over the Oregon and Greeley, Salt Lake and Pacific branches, but regular trains run over every other mile represented by these figures.